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Original Article

Predictors of Early Mortality After Aortic Valve Replacement in Middle-Aged Rheumatic Patients

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Abstract

Background: Several risk factors, including emergency surgery, predicted early mortality after aortic valve replacement (AVR). Euroscore II is used to predict the mortality after cardiac operations. We aimed to review our experience in AVR and determine the early mortality predictors

Methods: We collected the data of 200 rheumatic patients who had standard AVR in two centers. Median sternotomy and cardiopulmonary bypass were used in all patients. Transcatheter and minimally invasive aortic valve replacement patients were excluded. We used 15 types of aortic valve prostheses, either mechanical or biological. Follow-up echocardiography was done in the intensive care unit, on discharge, and one month after discharge.

Results: 128 patients (64%) had mechanical AVR, and 130 patients (65%) were males. The mean age was 48.2 ± 19 years, and body mass index was 1.8 ± 0.2 Kg/m2. The mean preoperative ejection fraction was 54 ± 9.4 %, end-diastolic dimension was 5.3 ± 0.8 cm, and end-systolic dimension was 3.5 ± 0.9 cm. Nine patients (4.5%) died in the early postoperative period (6 months). Euroscore II was the only factor significantly associated with early mortality (P value= 0.031). The mean Euroscore II was 1.3 ± 0.9 and 10.1 ± 10.7 for survivors and non-survivors, respectively.

Conclusion: Euroscore II score was significantly associated with early mortality after aortic valve replacement in rheumatic patients and can be used for risk stratification in those patients.

KEYWORDS
Aortic valve replacement; risk scores; Euroscore II; rheumatic heart disease

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Introduction

Predictors of mortality after aortic valve replacement (AVR) varies widely among the published series [1,2]. This variation is attributed mainly to different population characteristics, valve pathology, and different surgical outcomes in various centers.

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Several risk stratification scores (Euroscore I, Euroscore II, Society of thoracic surgery (STS) score, and the Australian model) were compared to predict the operative mortality after isolated AVR [3]. The Euroscore I had a poor calibration value and overestimated the mortality; however; the other scores correlated well with the outcome, and the highest accuracy was reported with STS score [3-5]. Other studies found that the Euroscore II was as effective as the STS risk score in predicting operative mortality [6]. Additionally, the Euroscore II has the additional benefit of having greater flexibility in terms of its applicability to a variety of cardiac surgeries. Most risk score systems have benefits and drawbacks and are meant to help rather than to govern clinical decision making. Several authors believe that no clinical decision should be made solely based on a calculated risk score, and every risk score system should be validated on different patients' subset in different areas [6]. The objectives of this study were to report our experience in AVR and to determine the predictors of early mortality.

Patients and Methods:

Design and Patients:

This is a retrospective cohort study including 200 patients who had AVR for rheumatic aortic valve disease during the period from January 2011 to December 2016. Patients with other valve pathology and those who had minimal invasive or transcatheter AVR were excluded from the study. The Ethical Committee and Research Center approved the study, and the patients' consent for data retention and utilization for research purpose was taken during the procedure consent.

Data collection:

We collected the data from the medical charts, including the preoperative patients' characteristics, comorbidities, echocardiographic data, and postoperative complications. Patients enrolled in this study were referred from the Cardiology Department after a physical examination, chest x-ray (CXR), echocardiography, and routine preoperative investigations were done. Cardiac catheterization was performed for cases older than 40 years and those with clinically significant chest pain. The decision for surgery was decided after multidisciplinary discussion with the heart team. Indication of surgery was based upon echocardiography, cardiac catheterization, and the severity of patient symptoms. Informed consent was done for the cases scheduled for surgical AVR after explaining the nature of the disease, options of treatment, type of the prostheses, and risk factors.

Operative procedure:

General anesthesia was induced after insertion of the venous and arterial lines. We routinely use Trans-esophageal echocardiography (TEE) to confirm/re-evaluate the aortic valve and other valves and assure good deairing. AVR was performed through a median sternotomy. Pericardial stay sutures were placed, heparin (400 IU/kg) was infused, and aortic cannulation followed by two-stage venous cannulation and retrograde cardioplegia cannula were inserted. Target active clotting time (ACT) was 400 seconds to initiate cardiopulmonary bypass (CPB), antegrade blood cardioplegia, either cold or warm, was used according to surgeon preferences. This was followed by retrograde cardioplegia if needed, plus intermittent doses of retrograde with occasional doses directly down the coronary ostia. Left ventricle (LV) vent was inserted through the right superior pulmonary vein. The aortotomy is performed as small transverse or oblique incision one cm above the right coronary artery (RCA) then extended laterally towards the left coronary artery (LCA) ostium, then medially in an oblique fashion towards the middle of the non-coronary sinus. The valve was inspected then resected along the annulus. We debrided the calcium, then sized the valve and placed horizontal mattress sutures along the annulus (using 2-0 braided pledged). The sutures were passed through the valve ring; then the valve was seated.

Postoperative care:

The patient was kept in the intensive care unit (ICU) ventilated until he/she became fully conscious with stable hemodynamics and being able to protect the airways when extubated. Anticoagulation was given permanently in mechanical valves and for three months in biological valves. INR was kept between 2-2.5. Follow-up echocardiography was done in ICU, on discharge, and one month after discharge. The patient was discharged home, and the instructions

regarding the anticoagulation, fever, sternal protection, and further follow-up were given.

Study outcome:

The outcome of this study was the early mortality defined as mortality occurring within 6 months of the operation, whether during hospitalization or after discharge.

Statistical analysis:

The data were analyzed using SPSS 20 (IBM Corp, Chicago, IL, USA). Continuous variables were expressed as mean ± standard deviation, median, and interquartile range. Categorical variables were expressed as number and percentage. Student t-test or Mann-Whitney test were used to compare continuous variables and Chi-square, or Fisher exact tests were used to compare categorical variables. A p-value of less than 0.05 was considered significant.

Table 1: Baseline characteristics of the patients.

Variable	Total Patients (n=200)
Age (Years)	
Mean ± SD	48.2 ± 19
Median (IQR)	50 (33- 63)
Gender (n (%)	
Male	81 (71.7%)
Female	32 (28.3%)
BMI (Kg/m2)	
Mean ± SD	28.7 ± 6.8
Median (IQR)	28.4 (23.6-32.8)
BSA (m2)	
Mean ± SD	1.8 ± 0.2
Median (IQR)	1.8 (1.6- 2)
ES II	
Mean ± SD	1.6 ± 2.3
Median (IQR)	0.9 (0.6- 1.7)

SD: Standard deviation; BMI: Body mass index; BSA: Body surface area; ES: Euroscore

Results

Preoperative data:

Our study included 200 patients, 128 had mechanical AVR (64%), and 130 were males (65%). Fifteen different prostheses were used, including both mechanical and bioprostheses. Valve sizes ranged between 19 and 27, and size 19 was used in 12 patients (24%). The mean age was 48.2 ± 19 years, and body mass index (BMI) was 1.8 ± 0.2 Kg/m2. Aortic stenosis was the main pathology in 66.5% of the patients, and 33.5% had regurge or mixed pathologies. The mean preoperative Euroscore II for all patients was 1.8 ± 0.2. Isolated aortic valve replacement was performed in 130 patients (65%), 29 patients (14.5%) had concomitant coronary artery bypass grafting, 26 patients (13%) had double valve replacement, and 15 patients (7.5%) had triple valve surgery. Bentall procedure was performed in nine cases (4.5%). 29 patients (14.5%) had reoperation. Table 1 showed the baseline characteristics of the patients. The mean preoperative ejection fraction (EF) was 54 ± 9.4%, the end-diastolic dimension (EDD) was 5.3 ± 0.8 cm, and the end-systolic dimension (ESD) was 3.5 ± .9 cm. (Table 2)

Table 2: Baseline Echo characteristics of the patients

Variable	Total Patients (n=200)
EF (%)	
Mean ± SD	54 ± 9.4
Median (IQR)	55 (50- 60)
EDD (cm)	
Mean ± SD	5.3 ± .8
Median (IQR)	5.3(4.7- 6)
ESD (cm)	
Mean ± SD	3.5 ± .9
Median (IQR)	3.4 (2.9- 4.1)
PAPs (mmHg)	
Mean ± SD	37.1 ± 12.9
Median (IQR)	30 (30- 45)
LVPWd (cm)	
Mean ± SD	1.2 ± .21
Median (IQR	1.1 (.9- 1.2)
AV peak gradient max (mmHg)	
Mean ± SD	76.8 ± 46.8
Median (IQR)	78.7 (34.4- 106.9)
AV mean gradient (mmHg)	
Mean ± SD	48.6 ± 22.6
Median (IQR)	48.7 (33.3- 64.2)

EF: Ejection fraction; EDD: End diastolic diameter; ESD: End systolic diameter; PAPs: systolic pulmonary artery pressure; LVPWD: left ventricular posterior wall diameter; AV: aortic valve

Early mortality:

There were nine deaths (4.5%) within the first six months after the operation; six were females and three males. Mortality occurred in five patients with mechanical valves, and four with biological valves. Timing of mortality is shown in Table 3. By univariable analysis, Euroscore II was significantly associated with early mortality (P value= 0.031). The mean Euroscore II was 1.3 ± 0.9 and 10.1 ± 10.7 for survivors and non-survivors, respectively (Table 4).

Postoperative complications were new-onset AF in 28 (14%), stroke in 17 (8.5%), complete heart block (CHB) in seven (3.5%), bleeding in 18 (9%), prolonged ventilation in 14 (7%), prolonged ICU stay in 26 (13%), sepsis in 12 (6%) and multiorgan failure in 10 (5%) patients.

Table 3: Timing of mortality

Variable	Total Patients (n=200)
Mortality	9 (4.5%)
Mortality < 30 days	4 (2%)
Mortality > 30 days	5 (2.5%)

Discussion

We retrospectively studied 200 patients who had AVR for rheumatic valve disease. The data were collected from two tertiary centers in two years. We reported a 4.5% mortality rate, which is consistent with international standards. The causes of death were end-organ failures with the hepato-renal syndrome and sepsis. The univariable analysis showed that Euroscore II was the only factor significantly associated with mortality.

Risk factors of mortality after AVR vary widely between different centers. Previously reported risk factors included old age, congestive heart failure, myocardial infarction, low EF, left ventricular dysfunction, emergency operation, type and size of the prosthesis, concomitant procedure especially coronary artery bypass grafting (CABG) and mitral valve replacement (MVR), long cross-clamp time, long cardiopulmonary bypass time, need of intra-aortic balloon pump, low cardiac output syndrome , and postoperative complications [1,7]

Swinkels and associates developed the AVR score as a simple risk score to predict 30-day mortality [8]. Euroscore and STS score, though more complex, they can provide a first quick-look impression of 30-day mortality after AVR. Hannan and associates reported a 3.33% mortality rate after isolated aortic valve replacement and 2.63% in patients who had mechanical valve prosthesis [9]. Mortality was higher in heterograft (4.22%) than homograft (3.28%) and with concomitant CABG (7.12%) [10]. Sharabiani and associates found the Euroscore II >5 to be a significant predictor of in-hospital/30-day mortality [11,12].

There are four risk scores (Euroscore, Euroscore II, STS score, and Australian AVR risk score) to predict mortality after cardiac surgery. Euroscore includes patient-related factors, cardiac-related factors, and operation-related factors [13,14]. The predictability of the scores could vary between different regions because of the nature of the disease and patients' characteristics. In our region, rheumatic heart disease is the primary cause of aortic valve disease, in contrary to the age-related aortic calcification in the developed countries. Additionally, the prevalence of comorbidities in our regions is different from that of the developed world. Euroscore did not consider the effect of liver disease on the outcome, which has a high prevalence in the Middle East.

Euroscore II had better predictive discrimination for operative mortality than Euroscore I and is comparable to the STS risk score [3]. This may be due to the inclusive nature of Euroscore II for many procedures that make it more flexible than the STS score for complex procedures. Euroscore II should be considered for calculating the risk score for complex cardiac surgical patients [3,13].

Several risk factors affect the outcome of aortic surgery and are not included in the risk score systems such as the type of the prosthesis [14], and several intraoperative factors have a significant effect on the postoperative course [15]. Comprehensive echocardiographic details are not included in most cardiac risk scoring systems, and no echocardiographic finding predicted the mortality in our series. It is essential to validate the scoring system in each region and study the region-specific risk factors that can affect the outcomes. In addition to the cardiac surgery-specific risk score systems, other non-cardiac

Table 4: Characteristics of the survivor and non-survivor

Variable	Survivor (n=191)	Nonsurvivor (n=9)	P-value
Age (Years)			
Mean ± SD *Median (IQR)*	47.6 ± 19.2 50 (32.2-63)	60 ± 9.3 54 (53-70)	0.143
Gender n (%)			
Male Female	130 (65%) 70 (35%)	2 (40%) 3 (60%)	0.137
BMI (Kg/m2)			
Mean ± SD *Median (IQR)*	28.6 ± 6.9 28.3 (23.5 - 32.8)	31.6 ± 4.1 31 (28.2-35.2)	0.224
BSA (m2)			
Mean ± SD *Median (IQR)*	1.8 ± 0.2 1.8 (1.6 - 2)	1.8 ± 0.2 1.8 (1.6-2)	0.845
ES			
Mean ± SD *Median (IQR)*	1.3 ± 0.9 0.9 (0.6 – 1.6)	10.1 ± 10.7 10.1 (2.5-0)	0.031
EF (%)			
Mean ± SD *Median (IQR)*	53.8 ± 9.3 55 (50 – 60)	58 ± 13 65 (47.5-65)	0.070
EDD (cm)			
Mean ± SD *Median (IQR)*	5.3 ± 0.8 5.3 (4.7 – 6)	5.2 ± 0.6 5.2 (4.6-5.7)	0.695
ESD (cm)			
Mean ± SD *Median (IQR)*	3.6 ± 0.9 3.4 (2.9 – 4.1)	3.3 ± 07 3.3 (2.6-4)	0.487
PAPs (mmHg)			
Mean ± SD *Median (IQR)*	36.9 ± 13.2 30 (30 – 45)	40 ± 8.6 45 (30-0)	0.377
LVPWd (cm)			
Mean ± SD *Median (IQR)*	1.1 ± 0.2 1.1 (0.9 – 1.2)	1.0 ± 0.3 1.0 (0.9-1.1)	0.082
IVSd (cm)			
Mean ± SD *Median (IQR)*	1.15 ± 0.2 1.2 (1 – 1.3)	1.1 ± 0.2 1.2 (0.8-1.2)	0.712
IVSd/LVPWd			
Mean ± SD *Median (IQR)*	1 ± 0.1 1.1 (0.9 – 1.2)	1.2 ± 0.2 1.3 (0.9-1.4)	0.145
LV mass (g)			
Mean ± SD *Median (IQR)*	260.5 ± 93.7 235.7 (193 – 313.8)	200.1 ± 56.3 191.9 (150.5-257.8)	0.166
Calculated LV mass (g)			
Mean ± SD *Median (IQR)*	257.6 ± 92.4 230.1 (188.4 – 310.9)	196.7 ± 53.6 188.5 (149.7-251.8)	0.160

Table 4 (Continued)

Variable	Survivor (n=191)	Nonsurvivor (n=9)	P-value
LV mass indexed (g/m2)			
Mean ± SD	138.3 ± 50.5	108.5 ± 34.1	0.170
Median (IQR)	130 (104.4 – 169.6)	99.2 (83.1-143.3)	
AV peak gradient max (mmHg)			
Mean ± SD	77± 47.3	72.1± 39.8	0.787
Median (IQR)	80 (32– 107)	68.8 (40-105.9)	
AV mean gradient (mmHg)			
Mean ± SD	49.1± 22.7	39.1± 20.6	0.304
Median (IQR)	49.7 (33.8– 64.4)	39.7 (20.8-57.3)	

SD: standard deviation; BMI: Body mass index; BSA: Body surface area; EF: ejection fraction; ES: Euroscore; EDD: End diastolic diameter; ESD: End systolic diameter; PAPs: systolic pulmonary artery pressure; IVSD= interventricular septal diameter; LVPWD: left ventricular posterior wall diameter; AV: aortic valve

score systems were used to predict the outcome after cardiac surgery such as SOFA and APACHE scores [16].

Limitations:

This is a retrospective study in two centers with all the inherent defects of retrospective studies. Small patients number is another limitation. We used univariable analysis to identify risk factors for early mortality and the low events number precluded further multivariable analysis.

Conclusion

Euroscore II score was significantly associated with early mortality after aortic valve replacement in rheumatic patients and can be used for risk stratification in those patients.

Conflict of interest: Authors declare no conflict of interest.

Conference presentation

This research was presented as an oral presentation in the 5th international congress of update in cardiology & cardiovascular surgery held in Antalya, Turkey 27-30 Mar 2019. "Euroscore is the only prdictor for early mortality after aortic valve replacement in middle aged rheumatic patients".

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